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SCIENCE EQUIPMENT IN THE ELEMENTARY SCHOOL.

COLORADO UNIV., BOULDER, ELEM.SCI. ADVISORY CENTER

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PROCEDURES FOR IMPROVISING LABORATORY EQUIPMENT FOR AN ACTIVE ELEMENTARY SCIENCE PROGRAM AND SOME SUGGESTED APPLICATIONS ARE PRESENTED. NEW COURSES OFTEN REQUIRE APPARATUS KITS AS WELL AS TEACHER'S GUIDES IN ORDER FOR THE PROGRAM TO BE CARRIED OUT AS DESIGNED. AS SCIENCE PROGRAMS EXPAND, MORE VERSATILITY, FLEXIBILITY, AND BROADER APPLICATION ARE REQUIRED. PREPARED KITS ARE INADEQUATE FOR GENERAL APPLICATIONS AND OFTEN REQUIRE MULTIPLES OF A CERTAIN PIECE OF EQUIPMENT. THOUGH A CENTRAL SET OF SCIENCE EQUIPMENT MAY BE PRACTICAL IN SOME CASES, IT IS SUGGESTED THAT EACH CLASSROOM HAVE ITS OWN STORE OF EQUIPMENT AVAILABLE AT THE MOMENT OF SUGGESTION OF SOME NEW AND EXCITING IDEAS. STUDENTS CAN OFTEN IMPROVISE WHEN COMPLETING AN ACTIVITY, THUS ADDING VALUE TO THE EXPERIENCE. MATERIALS FOUND USEFUL FOR A CLASSROOM ARE LISTED, BUT THE LIST SHOULD BE CONSIDERED ONLY A ROUGH GUIDE. COSTS ARE INDICATED FOR MANY ITEMS. PHOTOGRAPHS AND NARRATIVE SUPPLEMENT THE LIST AND SUGGEST INNOVATIVE APPLICATIONS. (DH)

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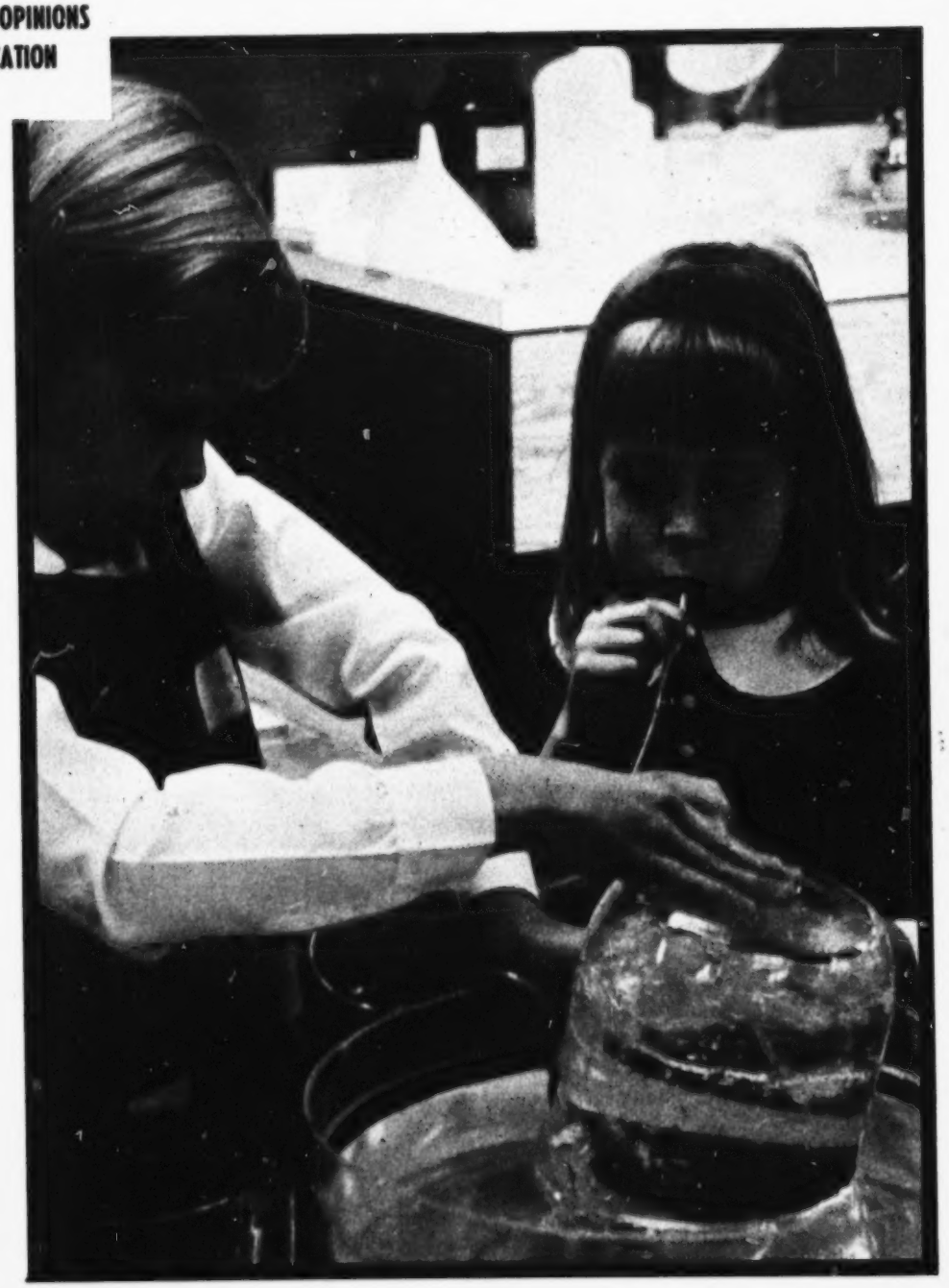

SE 004 435

ELEMENTARY SCIENCE ADVISORY CENTER, UNIVERSITY OF COLORADO, BOULDER

S C I E N C E E Q U I P M E N T

I N T H E

E L E M E N T A R Y S C H O O L

MARCH 1967

Elementary Science Advisory Center
University of Colorado
Boulder, Colorado 80302

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SCIENCE EQUIPMENT IN THE ELEMENTARY SCHOOL

Science has come to play a more important part than ever before in the curriculum of the elementary school. The central emphasis of most of this new science has been that children should learn from nature, from setting and carrying through their own investigations. Thus it is laboratory work and field work, rather than the use of texts and lectures, that dominates this new development. Teachers' guides are often accompanied by kits of apparatus, specially constructed for particular uses the curriculum designers had in mind. Such equipment has proved its usefulness, and through its use many teachers have discovered that laboratory science in the classroom can be an exciting educational adventure.

As schools tackle an ever wider range of science topics, however, the collection of special kits does not really add up to a generally well-stocked, reasonably priced elementary school laboratory. As teachers and children are liberated from set lines of study, moreover, and develop the capacity to pursue investigations where interest and opportunity lead, it becomes imperative that the school have a wide range of simple equipment and materials - to meet planned lesson needs and for improvising new apparatus as unforeseen investigations are undertaken. The design of apparatus is not the least of the scientist's skills. The ingenuity and manual skill which may be called forth from children in producing apparatus to meet their own particular needs are likewise an important part of science in the classroom.

The child who has built his own apparatus from familiar materials is more likely to relate his findings to the everyday happenings in the real world outside than are those whose experience is limited to the "conjuring trick" atmosphere of the ready-made science kit.

Not only are the prepared science kits inadequate for equipping a general purpose lab, but they have another inherent disadvantage in many cases. They are planned for a closely scheduled school day and thus, perforce, for a forty or sixty-minute science period in which everyone will be doing pretty much the same things. This requires a duplication of equipment which is sometimes very valuable but not always efficient. As the school introduces a wider and freer range of work in science, it may also discover the value of expecting and encouraging diversity in children's work. Individuals and small groups are "doing science" while the rest are working in other favored areas. The demand on the stock of science equipment then shifts: instead of wanting many pieces or sets of the same equipment, one wants a greater variety of generally usable equipment often - though not always - in only one or a few sets.

Improvisation in this way does not mean that no specialized scientific apparatus is needed; naturally it is, and that which is acquired should be of the very best quality that the school can afford. Often standard laboratory apparatus is little dearer than the scientific toys designed for elementary school use and of course it is usually vastly superior in quality. Careful improvization does mean, however, that whatever money is available can be used to secure those items of

specialized apparatus - microscopes, retort stands, aquaria and so on - that must be bought.

It is sometimes suggested that a central set of scientific apparatus should be built up in the school and that class teachers should borrow from this as the need arises. This system is particularly helpful in the case of the more expensive apparatus previously mentioned. It cannot, however, fully meet the needs of the individual teacher, any more than the establishment of a central library means that a more or less permanent stock of books is no longer needed in the classroom. The requirements of ongoing work, long-term experiments and the unexpected item of interest that crops up and demands immediate attention, as well as the problem of organizing a central store to satisfy everyone at once, make it imperative that some simple apparatus and a supply of materials be constantly available in every classroom.

This list of materials is drawn from personal experience and should not be considered more than a rough outline. The classroom has been chosen as the unit in estimating quantities. Considerations of cost may in some cases (e.g., microscopes) require that equipment be shared by several classes. In such cases we hope that there may be enough to have one or two pieces in each classroom. Thus, in a fifteen-room school it would be excellent to have one $12.50 microscope in each room, and a store of 30-35 in addition. But of course much excellent work can be done under less than ideal conditions.

Another possibility is the equipment of a special science room containing the

full list of materials and equipment (and probably much more, after a time). Individual teachers can then have their own stock of less expensive items (and a science table), using the science room for work with the whole class, for individual projects, and perhaps as the central store to draw on as need arises. It appears to us that there are many good patterns possible. Some will be more suitable in one school, others in another.

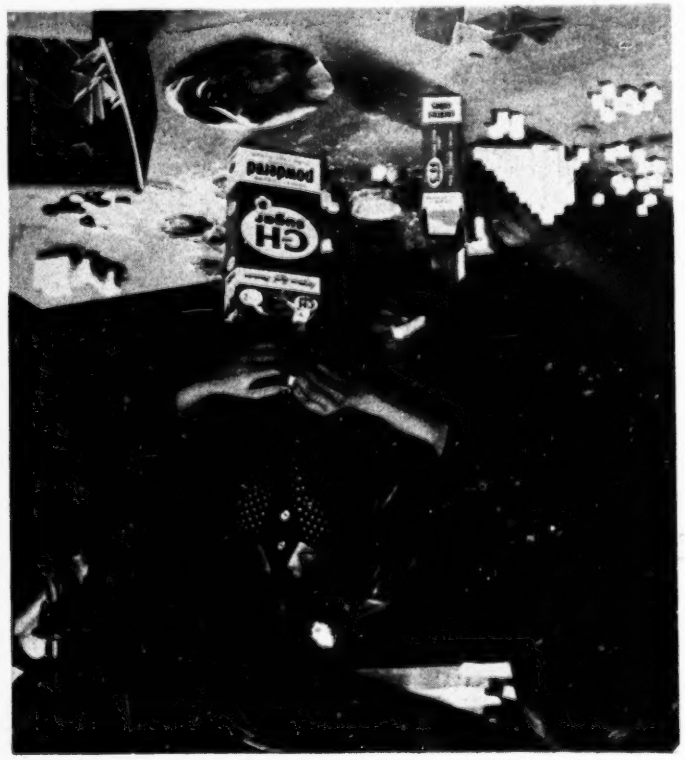
The list below is organized into rough categories for convenience, but many items could be put in several categories.

Some indication of cost has been given wherever possible, though in these days of varying prices this can only be a guide. A good deal of material will be brought by the children at no cost to the school.

A special category has been added called "junk". The items in this list are illustrative only and have one feature in common - they cost nothing, being brought by the children. But they are invaluable: a good laboratory, in university research or elementary school, always has an ample junk box.

The selection of materials in this guide has been based on experience in both English and American schools. The preparation of the guide nas been principally the work of Mr. Ronald W. Colton, Principal Lecturer in Environmental Science, The Northumberland College, and in 1966-67 Research Associate in the Elementary Science Advisory Center.

David Hawkins
Director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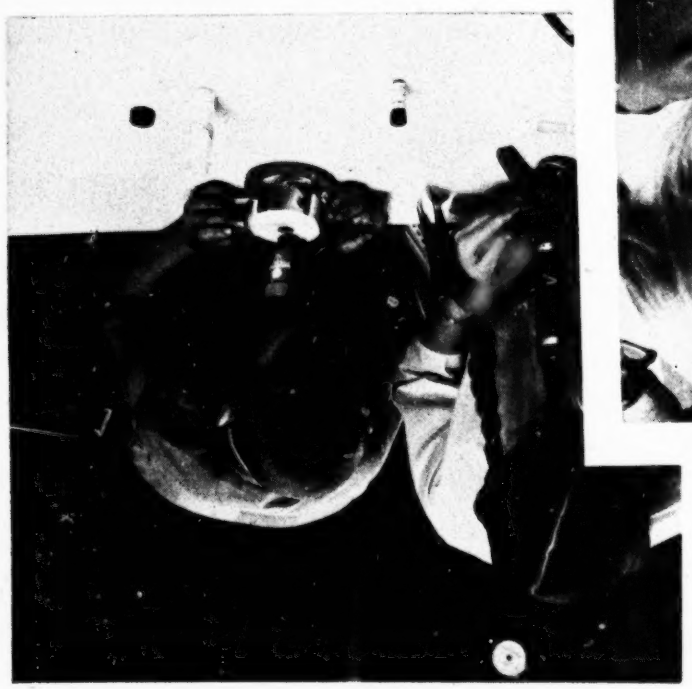


1. MEASUREMENT

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Balance, spring type, e.g., Ohaus Model 8011	250 gm.	1		2.75	
Balance, scale, spring type	20 lb.	1		5.00	
Balance, twin-beam, e.g., Ohaus Harvard	0-200 x .1gm	1			
type 1550s				25.00	
or type 1200				15.00	
Balance, unequal arm		1			see page 18
Bathroom scale		1		4.00	
Weights	1-1000 gm.	1 set		11.50	
Weights	1-10 lb.	1 set		11.00	
Washers, steel (for weights)	Approximate sizes				see notes
	2¼"	8 lb.	.30/lb.	2.40	
	1 3/4"	4 lb.	.30/lb.	1.20	
	1¼"	2 lb.	.30/lb.	.60	
	7/8"	1 lb.	.35/lb.	.35	
	3/4"	1 lb.	.40/lb.	.40	
	5/8"	½ lb.	.50/lb.	.25	
Graduated cylinders	100 ml.	2	1.00	2.00	

MEASUREMENT, continued

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Plastic kitchen measures	1 cup-1 gal.	set of 3-4		2.00	
Measuring spoons		1 set		.20	
Egg timer		1		.60	
Yard sticks		6			
Meter sticks		3	.75	2.25	
Sewing tape measures	5'	3	.25	.75	
Surveyor's tape	50'	1		4.00	
Outside calipers	8"	1 pr.		3.20	
Inside calipers	6"	1 pr.		3.20	

2. MATHEMATICS EQUIPMENT

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Abacus		1		2.75	
Games					see notes
Chess, Checkers, Tower of Hanoi, Chinese Checkers, Hex, etc.					
Framed pegboard	4' x 4'	1			see notes and Section 10
Golf tees		200	50/.40	1.60	
Blocks, wooden	2" x 4" x 4"	6			see Section 10
	2" x 4" x 8"	6			
	2" x 4" x 16"	6			
Sugar cubes		2 boxes	.25	.50	see page 12
Attribute blocks E.S.S.		1 set		12.00	see page 13
Cuisenaire or similar mathematical structural apparatus		1 set		10.00	
Pencil compasses		6	.90	3.40	
Protractors	180° large	2	.75	1.50	
	360° large	1		1.75	
Graph paper					
Paper tape, rolls	½" wide	3	.17	.51	see notes
	2½" wide	3	.50	1.50	

3. FORCE AND MOTION

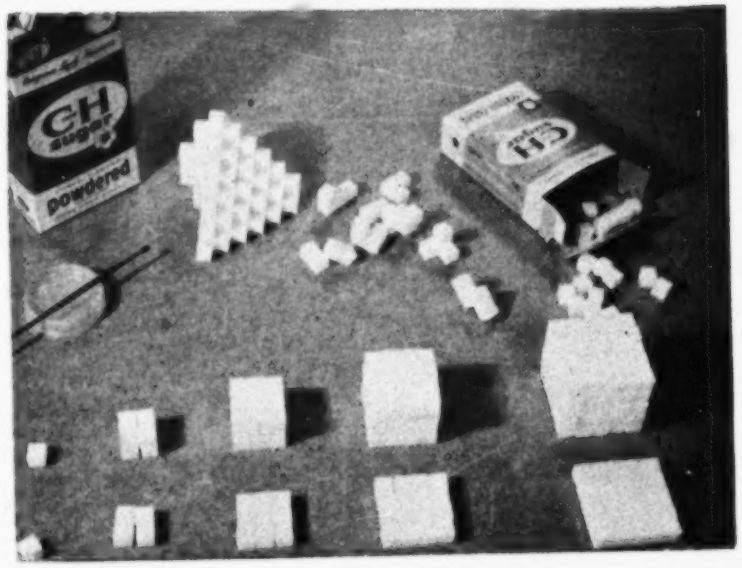
ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Pulleys					
with hooks	2½" nylon, Wards 60B18878	2	.75	1.50	
miscellaneous pulleys, e.g., clothesline		10			
Turntable (old phonograph)		1			
Helical springs, assorted		30		7.00	
Balls					
tennis, table tennis, billiards, rubber, polystyrene, etc.		1		2.40	
Toy gyroscope		6'			
Aluminum channelling					
Rope hoist	Wards Z84A9713M			4.29	
Pendulum supports					see page 19

4. FLUIDS

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Plastic water carriers	2-3 gal.	3	.75	2.25	
Plastic bowl, large	18" dia.	1		.75	
Plastic buckets	2-3 gal.	2	.60	1.20	
Plastic wading pool		1		2.00	
Miscellaneous containers including preserve jars and 1 gallon cider bottles					
Tubing, clear plastic, rigid	1" outside dia.	6'	.62/ft.	2.52	see page 23
	3/4" outside dia.	6'	.35/ft.	2.10	
	½" outside dia.	6'	.25/ft.	1.50	
	5/8" outside dia.	6'	.12/ft.	.72	
Clear plastic cylinders	6" dia.			10.00	see page 22 and Section 10
	18" high	1			
	12" high	1			
Small plastic cylinders	1½" x 8"	20			
Eye droppers		48	.50/12	2.00	
Syringes, plastic	Large, 50-200 ml.	10	.75	6.50	see notes
Garden hose, with couplings and spray	25'			4.00	
Funnels, plastic	4" dia.	10	.40	4.00	
Tubing, clear plastic, flexible	6-8 mm. internal dia.	10'	.15/ft.	1.50	see page 23
Tubing, rubber	6-8 mm. internal dia.	10'	.12/ft.	1.20	
Tire pump				1.50	

FLUIDS, continued

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Balloons		150	1.00/50	1.50	
Dilution trays		10			see notes
Windex sprayer				.20	
Aquarium	20" x 10" x 10"			14.00	

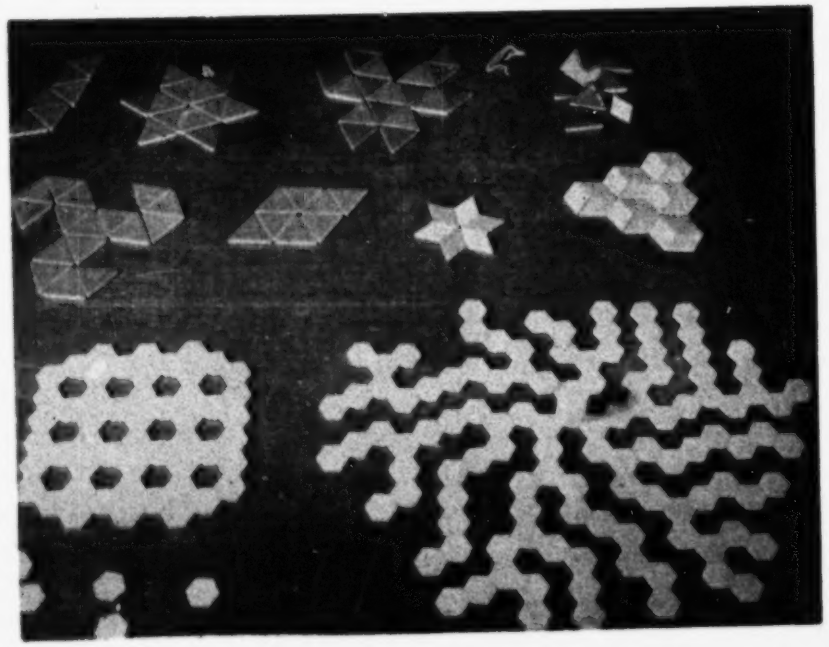


SUGAR CUBES

Sugar cubes are variously labeled, the smaller being called "cocktail cubes". They can be used for many construction purposes, especially by children who can manage the small sizes happily. Many shapes of structures will emerge. These can be made permanent by "gluing" the cubes together with a thick paste of powdered sugar and water, applied with a brush, using a light pressure for a few moments. When the paste has had time to crystallize, a firm bond results.

TILES

Small ceramic tiles are cheap and available in abundance. They can be used for the construction of many sorts of geometrical patterns. They are available in tile shops as squares, triangles, hexagons, diamonds, etc. "Negative" patterns can be obtained by lifting out tiles from a solid array with a bit of plasticene. "Growth" patterns can be built up according to "rules of growth" that children invent, telling where new tiles can be added, and where not.



WOODEN BLOCKS

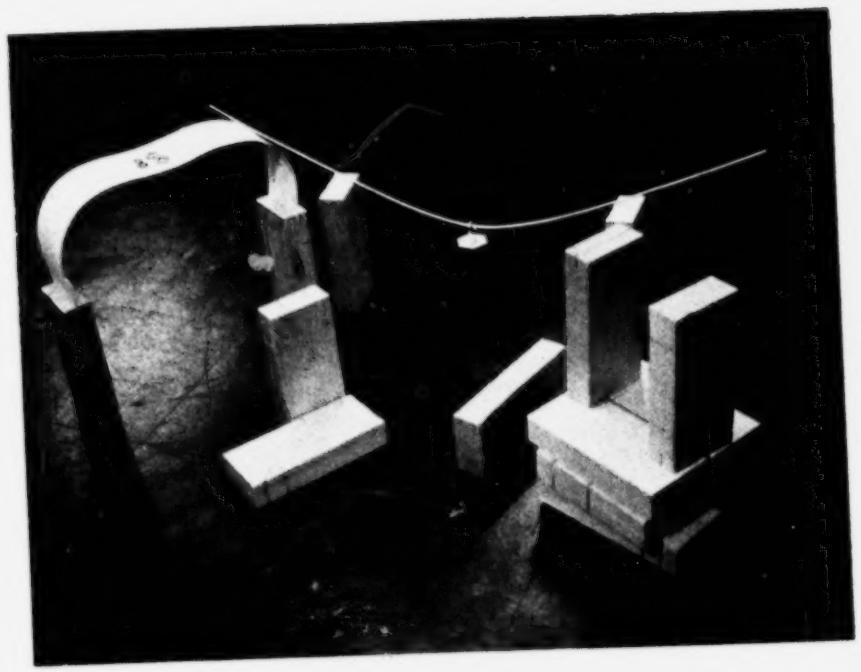
Wooden blocks, cut from clear 2" x 4" stock and sanded, have many uses other than the traditional use of kindergarten blocks: supports and structural members, problems in stable and unstable balance, etc. If the blocks are slotted with saw cuts to hold manila paper or construction paper, they will support bridges and trusses.

ATTRIBUTE BLOCKS

Attribute Blocks* are usable in many ways by young children. They are accompanied by an excellent guide suggesting many uses.

*available from

Educational Services, Inc.
55 Chapel Street
Newton, Mass.
02158



5. ELECTRICITY AND MAGNETISM

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Batteries, flashlight	1½v	20	.10	2.00	
Bulbs, flashlight	2 wattages, 1½v	6 doz.	1.10/12	6.60	
Bulbholders, M.E.S.		3 doz.	2.00/12	6.00	
Clips, Fahnstock		100	1.00/12	8.00	
Clips, Alligator		12		1.00	
Wire					
copper, bare	20 gauge	2 lb.		2.90	
copper, insulated	20 gauge	1 lb.		2.76	
copper, enamelled	24 gauge	1 lb.		2.18	
Extension cords	115v	2	.50	1.00	
Lamp sockets	115v	6	.22	1.32	
Compasses					
magnetic, plotting	10 mm. dia.	2 doz.	.10	2.40	
magnetic		1 doz.			
Alnico bar magnet	50 mm.	2	.50	1.00	
Plastic magnets		30	.02	.60	

6. HEAT

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Thermometers					
wall	-30° to 125°F	2	.70	1.40	
chemical, short pattern	0° to 110°C	1 doz.	1.70	20.00	
maximum and minimum		1		7.00	
Burner, spirit		4	1.00	4.00	
Electric hotplate, double burner		1		6.00	
Aquarium heater		1		3.75	
Aquarium thermostat		1		7.50	
Aquarium thermometer		1		1.68	
Candles, birthday		6 doz.	.15/12	.90	

7. OPTICAL EQUIPMENT

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Microscope, 100x, Bausch and Lomb	Ref. #31.25.15	15	12.50	187.50	
Microscope, binocular, Bausch and Lomb	Ref. #SSM15	2	50.00	100.00	
Microprojector					
Microscope slides		100		1.65	
Plastic cover slips		200	.80/100	1.60	
Magnifiers		10			
Linen tester lenses		10	.65/5	6.50	
Lenses, miscellaneous					
Prisms, large		2	2.10	4.10	
Shaving (concave) mirrors		2	.55	1.10	
Mirrors, steel	5" x 8"	30		15.00	
Mirrors, glass	various sizes	10		7.50	
Colored gelatin sheets or colored cellophane	assorted colors	10	.21/roll	2.10	
Light source					see notes

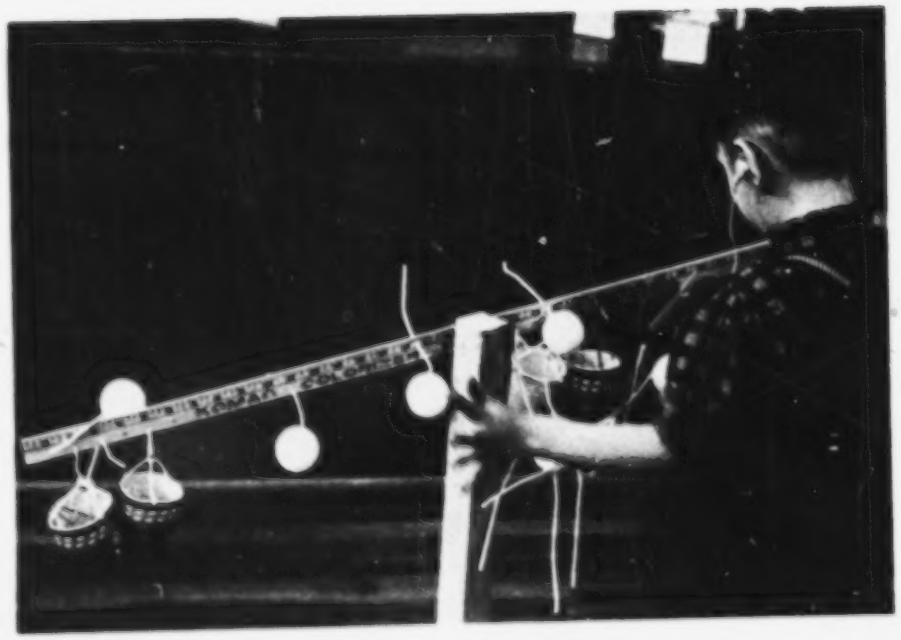
8. LIVING THINGS

A vast array of apparatus is available from biological suppliers, most of which is perfectly satisfactory and correspondingly expensive. Yet the children themselves can make almost everything that is needed to keep a range of living things in the elementary school, at very little cost. Bird and mammal cages may be constructed from wire mesh and hardboard, insect cages from fabric netting or transparent plastic. If a large aquarium is to be kept then this and its accessories will have to be bought, but a number of smaller aquarium jars or transparent plastic boxes will probably be of greater value anyhow. Plants may be grown in plastic drinking cups or other food containers, and plant troughs and terraria are simply devised and constructed with wood and polyethylene sheeting. Other sections of this booklet list these and other materials and apparatus which are useful in the study of living things. Among them are:

Aquarium thermostat
Aquarium heater
Containers of various kinds
Cotton
Drinking cups
Filter papers
Foam plastic
Hardboard ("Masonite")
Hardware cloth
Lenses
Lumber
Microscope
Mosquito netting
Peat
Petri dishes
Plastic tubes
Plastic and glass sheets
Polyethylene sheets and bags
Plastic shoe and sandwich boxes
Sand

BALANCES

Equipment for weighing and balancing is likely to be much used, but is often seen too narrowly. There is an excellent Elementary Science Study guide on this very rich subject, The Balance Book (Trial Teaching Edition). The unequal arm balance (see top right) has about it the flexibility of use and the invitation to explore, to disentangle variables, that has been designed out of the conventional balance, useful as it is.



PENDULUM PATTERNS

Patterns produced by a sand-filled pendulum bob. The bob was hung from separate hooks, the two strings being held together (by a twisted pipe cleaner) to form a Y.

MAGNETIC PENDULUM

A
magnet
suspended
above
other
magnets.

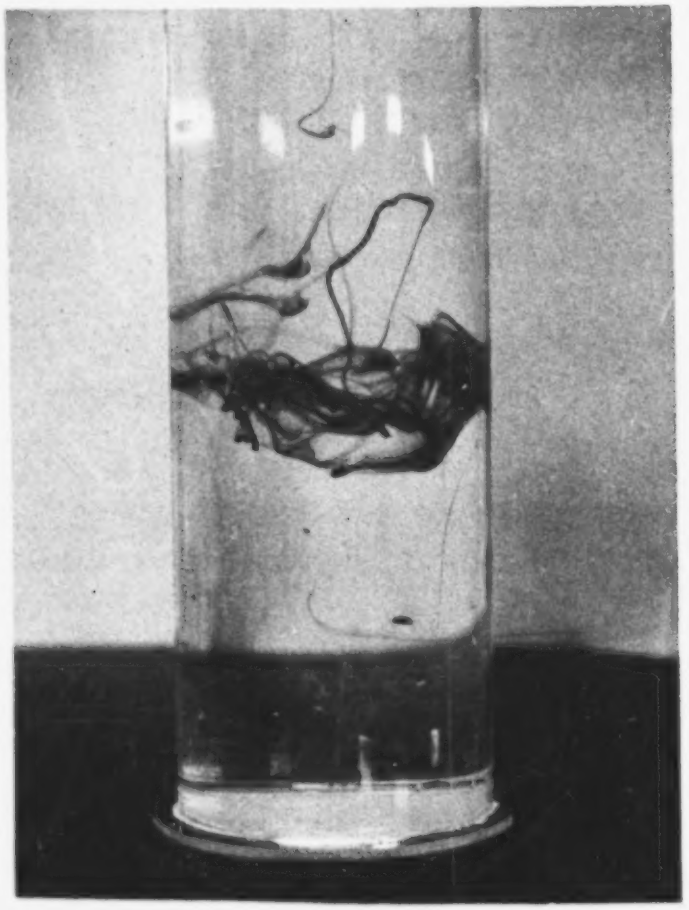
What
will
it
do?

9. TOOLS

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
"C" clamps	4"	2	1.00	2.00	
Cork borers	1 set			2.60	
Drills, to ¼"	1 set			2.00	
File					
flat	10"	1		1.20	
triangular, fine	6" or 8"	1		.30	
Hammer	13 oz.	2	2.00	4.00	
Hand drill		1		2.00	
Pliers					
heavy		1		3.75	
pointed nose		1		3.75	
Rasp, wood, or "Surform"		1		3.00	
Resin core solder		1 lb.		1.10	
Saws					
coping saw and blades		1		.50	
hacksaw and blade		1		.20	
keyhole saw		2	.50	1.00	
tenon saw		1		3.00	
Screwdrivers		1 set		4.00	
Screwdrivers, electrcian's small		2	.40	.80	
Soldering flux		1 can		.25	
Soldering iron, electric		1		2.30	
Spirit level	9"	1		3.00	

9. TOOLS, continued

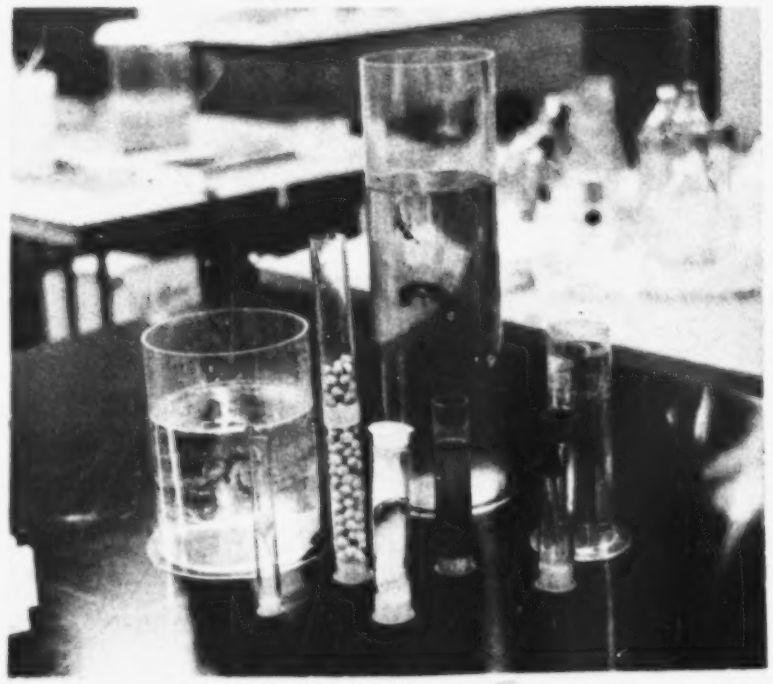
ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Tinsnips	10"	1 pr.		3.00	
Try square, carpenter's	8"	1		.90	
Wire cutters		1 pr.		3.00	
Vise, portable	3" or 4" jaw	1		3.00	



A drop of color falling through still water slowly develops interesting patterns without mixing, as in the photograph. If the water is stirred or put on the turntable of an old phonograph first, patterns of a different sort emerge.

PLASTIC CYLINDERS

Large diameter glass or plastic cylinders, which are so useful for work with fluids, are very expensive. However, offcuts of Plexiglass tubing up to 6" in diameter are relatively cheap and these, when cemented to bases cut from 1/8" Plexiglass sheet, using a cement such as Plasticrafts AA1 Adhesive, fulfill the purpose admirably. Smaller sizes find a variety of other uses.



PLASTIC TUBING

Blow down the tube and see how much air your lungs hold.

Children enjoy using this tubing, both rigid and flexible, for manipulating liquids and gases. With it, for example, they may watch the movement of marbles or lead shot falling through air or liquid, the rise of bubbles through colored water, the sorting of sand grains as they settle through water, or the migrations of small aquatic creatures.

How slowly the marbles fall in a tube filled with liquid.

Watch the bubbles rise through the long plastic "gas jar", time them, measure them.....

10. MISCELLANEOUS APPARATUS AND MATERIALS

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Bulldog clips	2"	12		1.80	
Clothes pins, spring		100		.85	
Laboratory stands, clamps and rings		2	3.60	7.20	
Marbles, glass		200	.15/36	.90	
Pegboard display rack					see page 31
Pegboard fittings			.5-.12/1		see page 31
Saucepans					
Salt-shakers, large aluminum		6	.25	1.50	
Sandwich boxes, plastic		20	.25	5.00	see notes
Shoe boxes, plastic		5	.50	2.50	see notes
Stethoscope	Edmund 50223	1		3.25	
Terry clips, assorted		100		5.00	
Test tubes, Pyrex	150 x 18 mm.	100		8.00	
Tinkertoy outfit, large		1		4.00	
Tuning fork		1		.75	
Aluminum sheet		10 sq. ft.		1.00	
Aluminum foil		1 roll		.30	
Adhesive, all-purpose				1.00	
Bags, polyethylene	8"x 6"or similar	100		1.60	
Ball bearings					see notes
Balsa wood		assorted bundle		2.00	
Ceramic tiles, small	various shapes				

10. MISCELLANEOUS APPARATUS AND MATERIALS, continued

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Cards; manila, large sheets				.63	
Chemicals					
Alka Seltzer tablets		1 tube		.63	
Ammonia		1 qt.		.29	
Baking powder		¼ lb.		.25	
Baking soda		½ lb.		.15	
Cooking oil		1 qt.		.89	
Detergent, liquid		1 qt.		.90	
Hydrochloric acid		1 lb.		2.00	see notes
Food colors		1 pt. ea.			see notes
Iodine		1 bottle		.40	
Karo syrup		1 bottle		.35	
Salt (ice cream)		10 lbs.		.37	
Vinegar		1 qt.		.24	
Washing soda		1 lb.		.15	
Water glass		1 qt.		.40	
Clay - natural		20 lb.		1.00	
Clay - oiled, plasticene		7 lb.		5.00	
Colored inks		4	.25	1.00	
Construction paper, colored and black					
Cotton, absorbent		½ lb.		1.00	
Cotton string		1 ball		.25	
Cotton cord (clothesline)		50 ft.		.35	

10. MISCELLANEOUS APPARATUS AND MATERIALS, continued

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Mosquito netting		2 sq. ft.	.40	.80	
Nails	assorted				
Nuts and bolts	assorted			2.00	
Paper clips		500		.40	
Paper fasteners	split type	300		1.50	
Peat, granulated, horticultural		28 lb.		1.75	
Peas, dried		4 lb.		.80	
Petri dishes	plastic, disposable	100		5.35	
Pins		8 oz.		1.50	
Pipe cleaners		100		.25	
Plaster of Paris		25 lb.		1.25	
Plexiglass sheet	1/8"	2 sq. ft.	1.35	2.70	
Plasticraft Adhesive AA1 for above		1 pt.		.90	
Pie dishes	paper	12		1.00	
Polyethylene sheeting	36" or 48" wide	100'		2.50	
Rubber bands	assorted	¼ lb.		.22	
Rubber sheeting, thin		2 sq. yd.			
Sand	fine mesh	50 lb.		2.00	
Sandpaper	various grades			2.00	
Screws	assorted			2.00	
Steel wool, fine		½ lb.		.20	
Styrofoam	assorted pieces			2.00	

10. MISCELLANEOUS APPARATUS AND MATERIALS, continued

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Dowel rod, assorted sizes		40'		2.40	
Drinking cartons		100		2.00	
Drinking straws, plastic		100		.60	
Drinking straws, waxed		400	.11/100	.44	
Emery cloth	various grades				
Filter paper circles or white blotting paper	150 mm.	100		.40	
Foam plastic sheet	¼"	1 sq. yd.		.60	
	½"	1 sq. yd.		.40	
Glass or transparent plastic sheets	about 1 sq. ft. in area each				see notes
Hardboard		18 sq. ft		2.50	see notes
Pegboard		32 sq. ft		4.50	see pages 30,31
Jars, miscellaneous					
Labels, tie on		200		.40	
Labels, stick on		200		.60	
Lead shot		7 lb.		2.00	
Lumber, planed	1" x ½"	50'		2.75	
	1" x 1"	50'		1.50	
	1" x 2"	50'		2.13	
	1" x 4"	20'		1.24	
Lumber, clear	2" x 4"	16'		4.00	For construction of blocks, see Math Eqpmt.

10. MISCELLANEOUS APPARATUS AND MATERIALS, continued

ITEM	DETAILS	QUANTITY	PRICE	TOTAL	COMMENT
Tape					
masking		2 rolls	.50	1.00	
Scotch		2 rolls	.50	1.00	
Scotch	colored	4 rolls	.40	1.60	
Thumb tacks		200		.20	
Tongue depressors		500		2.95	
Vinyl floor covering		2 sq. yd.	.10	.20	
White cloth		2 sq. yd.	.50	1.00	
White wool		½ lb.	.50	1.00	
Wire, piano	B and S 24 gauge	4 oz.		.81	
Wire mesh	¼" x ½"	1 sq. yd.	1.80	3.60	
		each			

11. JUNK

Old clocks and parts, mechanical and electrical

Clockwork motors

Gear wheels

Old egg beaters

Hand drills

Old bicycle or parts

Bicycle and automobile type tire tubes

Ball races and bearings

Carburetor parts

Springs of various sizes and types

Taps, ball valves

Bottles and jars of all sizes

Old teapots

Wood corks, sponges

Pastry cutters, muffin tins, molds

Boxes and cartons of all shapes and sizes - match boxes, date boxes

Food containers

Spools, cardboard tubes

Bottle caps

Locks and keys

Various nuts and bolts including very large sizes

Bicycle pump

Rubber suction discs

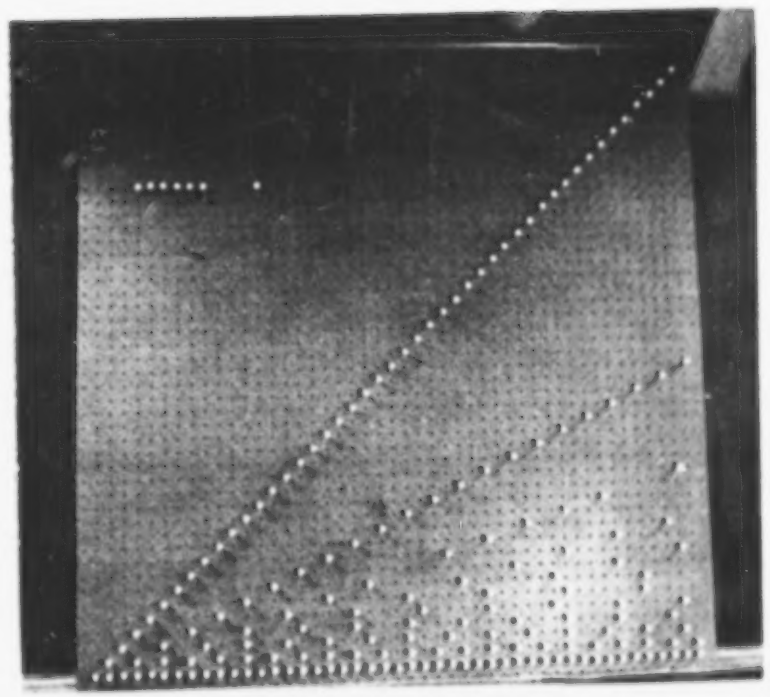
Strainers

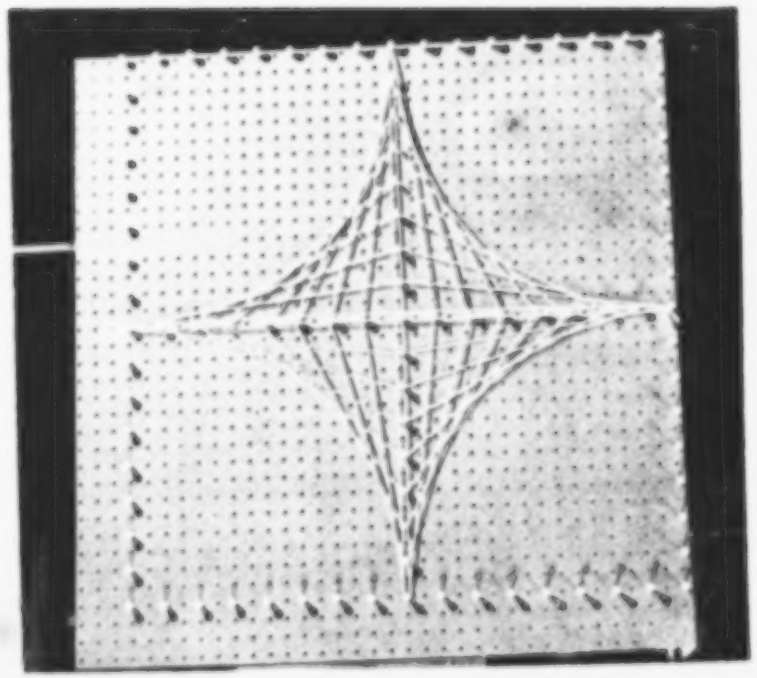
Scoops

Empty cans

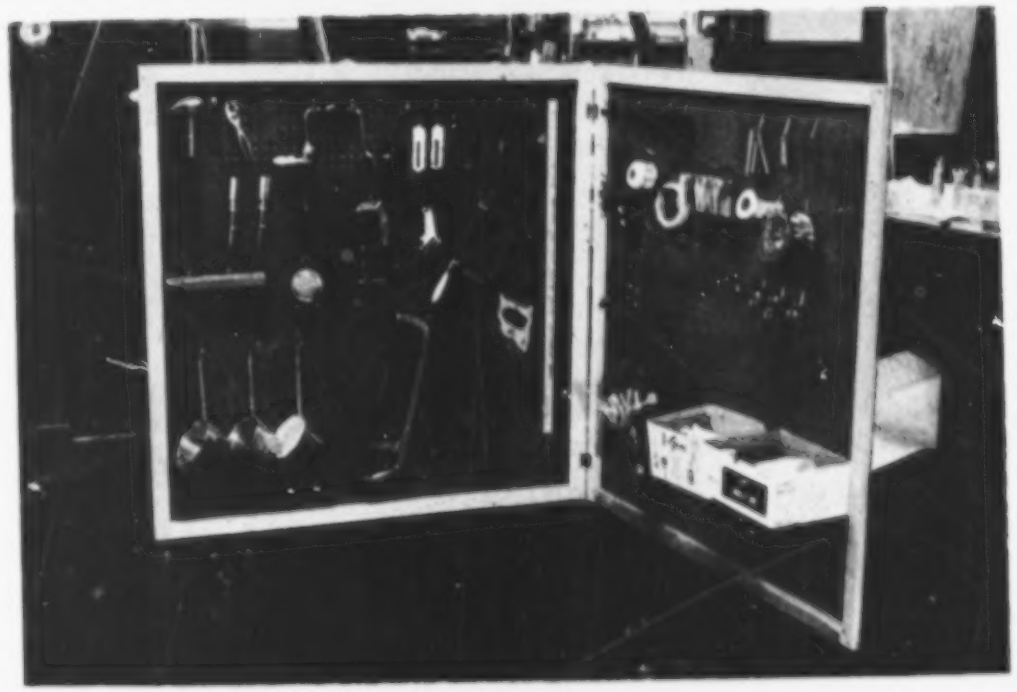
Squeezable detergent containers

PEGBOARD





There are many kinds of graphs, using paper tape, blackboard and chalk, paper and pencil. Pegboard and golf tees make a very nice kit for many purposes. These range from pictures like the old Sampler patterns to bar graphs to lattice patterns in which each tee represents two natural numbers, those of its row and column. (See the graph of the numbers and their factors, on this page.) Yarn or string can be stretched between the tees. A standard 4' x 8' sheet of pegboard makes two lattices of about 40 x 40 holes, and the tees are cheap in bulk amounts. A simple 1" frame gives stability and holds the pegboard away from the well.



Storage and display units

Storage of classroom equipment and materials is always a problem, aggravated in the case of science equipment by the number and variety of articles involved. Vertical sheets of pegboard, fitted with wire pegboard fittings such as are used in shop displays, provide good storage facilities for a large variety of apparatus and materials. Everything has a specific place and it is immediately obvious if that place is not filled. The board illustrated is free standing, made of two 4' x 4' pieces framed in 2" x 1½" lumber and hinged. It could double as a room divider to mark off a special science corner. Alternately it might be used in the more rigid arrangement shown on the right.

Ball Bearings These are relatively expensive, bought new. But any garage mechanic will rescue them for you from ball-bearing races he is throwing away, by breaking the race with a hammer. Tractor bearings, etc., are even larger. Uses: with a small hook and a drop of epoxy glue, pendulum weights. They respond to magnets as they roll by. And they go nicely down and up inclined planes, or aluminum channelling.

Dilution Trays The photograph may be enough suggestion. The trays can be used, for more sober quantitative work, to achieve serial dilution of colors, tastes, yeast suspensions, etc.: put concentrated food colors in the first row of cavities, one drop, with nine drops of water, in the next row. Then again, and again. How long before the color, or the taste, is gone?

Food Coloring It is wise to use this non-poisonous material for coloring water and other liquids, especially where young children are involved. Plenty of coloring material should be available; the little bottles on sale for domestic use are far too small. Larger bottles are available in some stores. Dry color is expensive - about $5 per lb., but this will make enough to satisfy a whole school for two or three years, so it is the most economical way to buy coloring.

Games and Puzzles Many games have a lot of implicit mathematics in them. Regardless of this a game corner provides opportunity for relaxation, withdrawal, conversa-

tion. Apart from old familiars such as checkers, chess, chinese checkers, we recommend several that we have used, particularly, "Count and Capture", an African counting game, and "Hex".

Glass Sheets

Glass sheets are used on a number of occasions, e.g., for observing the growth of roots and in color mixing experiments. To minimize breakages and to reduce the number of cuts, the glass sheet should be of reasonable thickness; 24 oz. glass is suitable. Thin picture glass is too fragile. Edges and corners should be bound with masking or some other tape. Sheet plastic is safer and of course much less liable to breakage but is expensive and surface scratches will eventually mar its transparency. Glass sheets 8" x 10" are big enough for most purposes. If much larger sheets are needed, then it would be safer to use plastic.

Hardboard ("Masonite")

Hardboard has a multitude of uses in constructing equipment. Where water resistance is needed, as for example, bases for terraria, use tempered hardboard.

Hydrochloric Acid

For many purposes vinegar is a suitable acid. Where a mineral acid is needed hydrochloric acid is the best to use and is safe if used diluted. Concentrated acid (marked 35.5% HCl) should be diluted with nine parts of water, adding acid to water, to give a suitable and safe acid.

Light Sources

A powerful, focused light source is valuable in the study of light and shadow. In conjunction with models made with balls of various sizes it may help children understand how day and night occur and to "see" the phases of the moon. A south window and mirrors will bring the real sun into the room - and it moves! A slide projector is the concentrated light source most likely to be available. It has many unintended uses when connected with prisms and mirrors. Used with the projection screen it brings the world of shadows into the classroom: hands, profiles, geometrical shapes, puppets - and even candle flames.

Paper Tape

For column graphs, making scales and many other graphing and measuring purposes. Particularly useful for discovering the relationship between diameter and circumference of circles. Diameter of the reel is measured, and a length of paper equal to the circumference can be unwound and compared.

Pendulums

The small pendulum supports are those provided with the Elementary Science Study unit on Pendulums, which has an extensive teacher's guide. See the picture on page 19. Many other kinds of supports are possible: hooks or tape in a doorway will support a pendulum or two, as will a ceiling beam or any rigid ceiling fixture. For individual work in a classroom we have used 3' lengths of 2" x 4", tapped for ¼" wing bolts. The supporting thread is wrapped into the threads of the bolt and passes down through a small hole. Turning the bolt thus changes the length of the pendulum, like the tuning peg in a stringed instrument. The 2" x 4" is held up

by two desks or tables.

A difficulty with short pendulums is that the plane in which they swing is likely to change disconcertingly. This comes partly from the wobble or flexing of an unsteady support, but mostly because the supporting thread rubs unevenly on the side of the hole it passes through. A half-split tongue depressor or other thin piece of wood will grip the thread tightly and may then be pinned or taped under the hole. It will prevent most of this turning or "precession". On the other hand this "nuisance" phenomenon can be an interesting one to study. Children might try the effect of letting the pendulum thread pass through various kinds of holes fastened an inch or so below the support - the slot in a plastic ruler, a washer, or a hole of some other shape.

Plastic Boxes — Plastic sandwich and shoe boxes find a multitude of uses for storage and experiment. They are excellent as temporary (or even more permanent) aquaria for it is often better to have several small aquaria than one large one. Each child, or group of children, can have a personal aquaria for observation.

Syringes — Large plastic syringes can be used in many ways (other than as water guns) if connected with water, plastic tubing, squeeze bottles, etc., for example, to start a siphon, or they can be used to transfer liquids from one container to another. They can also be used to handle gases (see the E. S. S. unit, Gases and Airs). Hold your thumb over the inlet

and pull until it pops. Pull out almost that far, and let go.....

Washers

For many weighing purposes arbitrary weights such as washers or paper clip are ideal and children are perfectly satisfied to express an answer in terms of, say, marbles or paper clips. When, as is often the case, we are comparing two sets of weights, then, if A weighs 20 washers and B 10, we can say that A is twice as heavy as B as confidently as if our weighing had been done in ounces or grams.